

THE UNIVERSE'S EVOLUTION

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(1999)

Based on a new theory of causality [1] and its development to the theory of the Universe [2], we show, in this paper, new ideas for building a theory of everything.

PACS No. : 01.55.+b

I. INTRODUCTION

The discovery of natural world around us is an indispensable activity of mankind. And looking for a single theory that can explain every phenomenon and every process is a good dream of scientists and especially physicists. Nowadays, physicists have been trying to find a single theory that unifies four familiar interactions, and they hope that it develops the theory of everything. A theory they believe to be the theory of everything is called the superstring theory. Notably, it is necessary to understand that the superstring theory gives us description which only can unite four familiar forces into a single framework.

Of course, whether it is really called the theory of everything or not since there are many unknown interactions (besides four familiar interactions) absents in the theory. Moreover, the theory of everything must give us a correct solution in every phenomenon and process (in all universe's dimension, in all energy level, in all universe's status and so fourth). The theory of everything is necessarily a theory of Creation, that is, it must necessarily explain everything from the origin of the Universe down to the lilies of the field. A theory of everything is also a theory of everyday. Thus, this theory, when fully completed, will be able to explain the existence of every phenomenon, the variation of every process, and many others.

However, there is another way on which we can reach the theory of everything. That is to find a single law that implies all known laws and, therefore, predicts unknown laws. The presence of this law has in every phenomenon, process and thing in nature. It is really to be the ultimate goal of all knowledge, the theory to end all theories, the ultimate answer to all questions.

The present article is the first one of a series that we would like to say about the law and the theory of causality as well as its implementation for building a theory of the Universe. We hope that some of the readers of this

article will find out that the law of causality is just the law of all laws, the theory of causality is just the single theory of everything, and perhaps they will be the ones to complete the quest for the Theory of the Universe.

The article is organized as follows. In Section 2 we introduce the ideas and concepts for leading the equation of causality [1]. In Section 3, as the main part of the article, we attempt to simulate briefly the process of the Universe's evolution [2]. The conclusions and prospects are given in Section 4.

II. THE EQUATION OF CAUSALITY

We can always conceive that the Universe is in unification. And a surefire fact is that the Universe's unification is only in a general intrinsic relationship which is nothing but the relationship of causality, and the unification only manifests itself in that causal form. Then, a question is put on what is the ultimate cause of everything? On further reflection, we find out that there exists an ultimate cause - that is the difference.

Truly, there would not exist anything if there were not the difference. If there were no difference, this world did not exist. And there is a fact that since the difference is the ultimate cause, it is the cause of itself, in other words, it is also the effect of itself. The difference causes the difference, the difference is the corollary generated by the difference.

In another way, we can imagine abstractly that the Nature is a set of positive actions¹ and negative actions². Then, what does the Nature act positively on? and what does the Nature act negatively on? The answer to these questions gives us a law. That is, what do not have any intrinsic contradiction is acted positively on, what do have some intrinsic contradiction is acted negatively on. Both the positive action (in front of a process) and the negative action (in back of the process) have a final goal that is to reach and to end at a new action.

¹Positive action means 'affirmation'.

²Negative action means 'negative'.

Thus, we have started to come to a theory, axiom of which is the difference, object of which is actions³ [1].

Consider two actions, we obtain a definition that co-existence of two actions which reject mutually generates contradiction. That is represented as follows:

$$M = \begin{cases} A \neq A & - \text{Action } K_1 \\ A = A & - \text{Action } K_2 \end{cases}.$$

This means the higher the power of mutual rejection between two actions K_1 and K_2 is the more severe the contradiction M will be. And the power of mutual rejection of two actions is estimated from the degree of difference. A contradiction which is solved means that the difference of two actions diminishes to zero. Herein, two actions K_1 and K_2 all vary to reach and to end at a new action K_3 .

The change, and one kind of which - the variation, is generated by contradiction. In exact words, the variation is the manifestation of contradiction solving. The more severe contradiction becomes the more urgent need of solving out of contradiction will be, and hence the more violent the change, the variation of the state, i.e. of contradiction will become. Call the violence, or the quickness of the variation of contradiction Q , the contradiction state is M , the above principle can be represented as follows:

$$Q = K_{(M)} M$$

where $K_{(M)}$ is means to solve the contradiction M . $K_{(M)}$ can be a function of the contradiction state. It represents the degree of easiness to escape the contradiction state. If the contradiction is characterized by quantities x, y, z, \dots , these quantities themselves will be facilities to transport the contradiction, degrees of freedom over which the contradiction is solved. Hence, the degree of easiness is valued as the derivative of the contradiction with respect to its degree of freedom

$$K_{(M)} \sim |M'(x, y, z, \dots)|.$$

Thus,

$$Q = a |M'| M$$

where the coefficient a generates from choosing the dimension.

Advance a quantity T , inverse of Q , to be stagnancy of contradiction solving. The sum of stagnancy in the process of contradiction solving from M_0 to $M_0 - \Delta M$ we call the time is generated by this variation

$$\Delta t \approx -\frac{T + (T + \Delta T)}{2} \Delta M.$$

Thus,

$$\lim_{\Delta T \rightarrow 0, \Delta M \rightarrow 0, \Delta t \rightarrow 0} \frac{\Delta M}{\Delta t} = -\frac{1}{T} = -a |M'| M.$$

Therefrom, we obtain the equation of causality,

$$\frac{dM}{dt} = -a |M'(x, y, z, \dots)| M(x, y, z, \dots). \quad (1)$$

Truthly, the difference is the origin of all, but it has the meaning in direct relationship, in direct comparison. Some state which has any intrinsic contradiction must vary to reach a new one having no intrinsic contradiction, or exactly, having infinitesimal contradiction. The greater the value of the contradiction derivative with respect to some degree of freedom is, the better the 'scent' for way out in that degree of freedom will be, the greater the strength of the solved contradiction over that degree of freedom will be.

It is easy to see that equation of causality (1) is represented as a 'classical' form. It can be developed to more general form in which the time is considered as a new degree of freedom. However, Eq. (1) looks like familiar equations, and we will use it for applying to concrete problems. Though the law of causality (1) is abstract its concrete form in each problem is very clear. And in the next Section we show the process of the Universe's evolution which lays the foundation for building a theory of the Universe.

III. THE PROCESS OF THE UNIVERSE'S EVOLUTION

A. The general mechanism

To survey clearly the evolution of the Universe, we firstly review four important concepts: time, space, matter, and motion.

About the time. Can the time exist independently, if it is separated from space, matter, and motion? Evidently, no. If the time were separated from motion, the conception of it would have no meaning. The time cannot self-exist, it is the effect of motion. No motion, no time.

About the motion. The motion also would not self-exist if it were separated from matter and space.

And about the matter. The matter also cannot self-exist without space. It exists owing to not only itself but also the coexistence of the space surrounding it. In

³Action here is a general concept of anything, it may be a function, a generator, an operator, or even a force, an interaction, a field, ect. depending on each considered subject.

essence, the matter is nothing but just some space with intrinsic relationship different from familiar space we see around us.

Imagine that all are vanished: matter, space,..., and in general, every difference is vanished. Then, there exists only one. It is homogeneous and limitless everywhere. It can self-exist. It is the first element. In this unique there is nothing, but there exists the 'Nothing'. The Nothing is the origin of all, the cause of all, since it has the first difference.

In Section 2, we have said the axiom of the theory of causality. That is the difference. Imagine that if the present Universe has many differences, the first state of the Universe will be the state which has fewest differences. It is logical to show that the first Universe's state is the Nothing, and the transformation chain "difference - contradiction - solving" is the expansion of the Universe.

A remarkable consensus has been developing recently around what is called "quantum cosmology", which proposes a beautiful synthesis of seemingly hostile viewpoints. In the beginning it was Nothing. No space, no matter or energy. But according to the quantum principle, even Nothing was unstable. Nothing began to decay, i.e. it began to 'boil', with billions of tiny bubbles forming and expanding rapidly. Each bubble became an expanding sub-universe⁴. Sub-universes can literally spring into existence as a quantum fluctuation of Nothing. Resonances of vacuum fluctuations create first elements of matter.

In Ref. [2] we show the elementary equation of Evolution

$$e^{\Sigma a M} \hat{\partial} M = e^{\Sigma(-)\Delta t} \dot{\partial} M, \quad (2)$$

and the conservation relation of quanta

$$\sum_{j,\dots,k} \sum_{i=0}^n \frac{(-)^i}{n!} C_i^n M_j \dots M_k = 0, \quad (3)$$

And similar to three interactive quanta

⁴Our universe is actually part of a much larger "multiverse" of sub-universes. Our sub-universe may co-exist with other sub-universes, but our sub-universe may be one of the few compatible with life. This would answer the age-old question of why the physics constants of the universe fall in a narrow band compatible with the formation of life. If the universal constants were changed slightly, then life would have been impossible.

where n is total of quanta, i is quantum number generated by each step of expansion of the Universe, C_i^n is binary coefficient.

It is easy to realize that Eq. (2) is also a form of equation of causality (1). But Eq. (2) gives us an important application in modelling the multiplication and the combination of quanta. There are two objects from Eq. (2) we can use to study: one is actions, the other is quanta. Studying actions gives us laws, equations, representations in each considered field. And studying quanta gives us models, classifications, arrangements of quanta. To describe the evolution of the Universe, it is better for us to investigate quanta.

Call $\alpha, \beta, \gamma, \dots$ quanta. For each quantum there is a rule of multiplication as follows

$$\alpha^n \rightarrow e^{\partial_\alpha} \alpha^n = \sum_{i=0}^n C_i^n \alpha^{n-i} = (\alpha + 1)^n \quad (4)$$

where n is order of combination. Although Eq. (4) is obtained from Eq. (2) in considering for quanta, it can be found meaningfully using the evolution principle shown in Ref. [2]. Eq. (4) itself represents the evolution of the Universe.

B. Examples for the doublet and the triplet

Using Eq. (4) we consider two stages in the process of the Universe's evolution: doublet and triplet.

For two interactive quanta the rule of multiplication reads

$$\alpha^n, \beta^n \rightarrow \frac{1}{2}(e^{\beta \partial_\alpha} \alpha^n + e^{\alpha \partial_\beta} \beta^n) = \sum_{i=0}^n C_i^n \alpha^{n-i} \beta^i = (\alpha + \beta)^n. \quad (5)$$

$$\alpha^n, \beta^n, \gamma^n \rightarrow \frac{1}{3}(e^{(\beta+\gamma)\partial_\alpha}\alpha^n + e^{(\gamma+\alpha)\partial_\beta}\beta^n + e^{(\alpha+\beta)\partial_\gamma}\gamma^n) = \sum_m^n \sum_i^m C_m^n C_i^m \alpha^{n-m} \beta^{m-i} \gamma^i = (\alpha + \beta + \gamma)^n. \quad (6)$$

And so fourth. Eqs. 5 and 6 can be drawn as schemata.

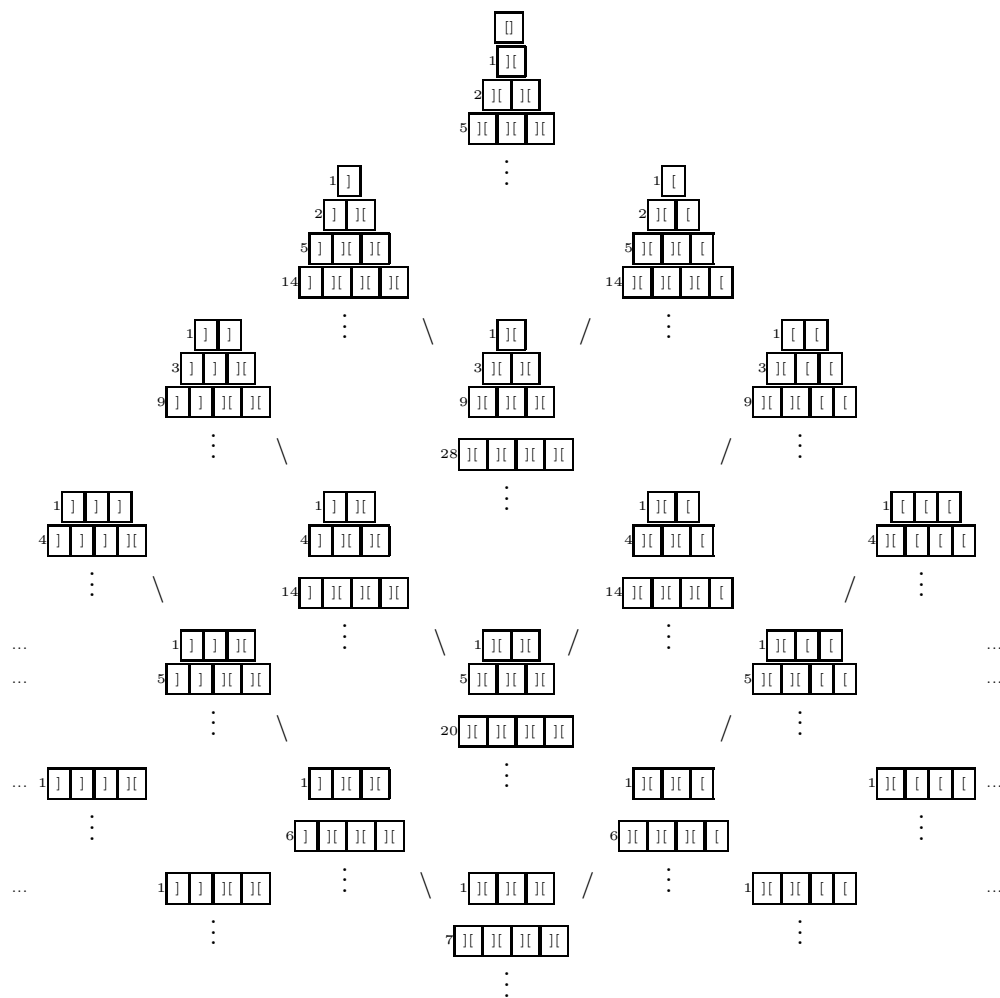
$$\begin{array}{ccccccccc}
 & & \vdots & & \dots & & \dots & & \dots & & \dots \\
 & & \underline{2} & & & & \overline{1} & & \overline{1} & & \\
 & & 0 & & & & & & \bigcirc & & \\
 & & \underline{2} & & & & 1 & & 1 & & \\
 & & \underline{2} \otimes \underline{2} = \underline{3} \oplus \underline{1} & & & & 1 & & 2 & & 1 \\
 & & \underline{2} \otimes \underline{2} \otimes \underline{2} = \underline{4} \oplus \underline{2} \oplus \underline{2} & & & & 1 & & 3 & & 3 & & 1 \\
 & & \vdots & & 1 & & 4 & & 6 & & 4 & & 1 \\
 & & \vdots & & 1 & & 5 & & 10 & & 10 & & 5 & & 1 \\
 & & \vdots & & \dots & & \dots & & \dots & & \dots & & \dots & & \dots
 \end{array} \quad (7)$$

is the schema for Eq. (5), where $\underline{2}$ means two quanta α and β . The numbers in the triangle is the binary coefficients which give us weights of classes. For example,

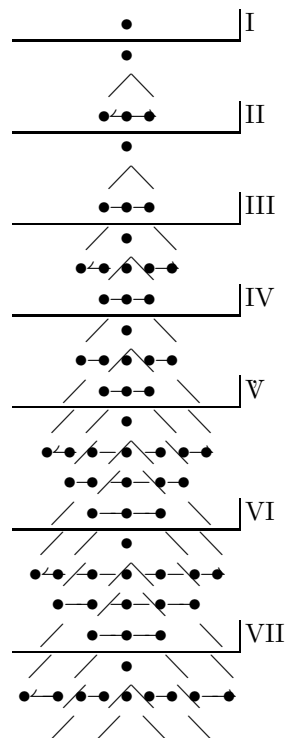
$$\underline{2} \otimes \underline{2} = \underline{3} \oplus \underline{1} = \begin{array}{ccc} & 1 & \\ 1 & \text{---} & 1 \\ & 1 & \text{---} & 1 \end{array}.$$

And similar to Eq. (6) we have

5



Arrange this diagram in the order of the levels we obtain the so-called periodic diagram



which is nothing but the Mendeleev periodic table built in the energy levels,

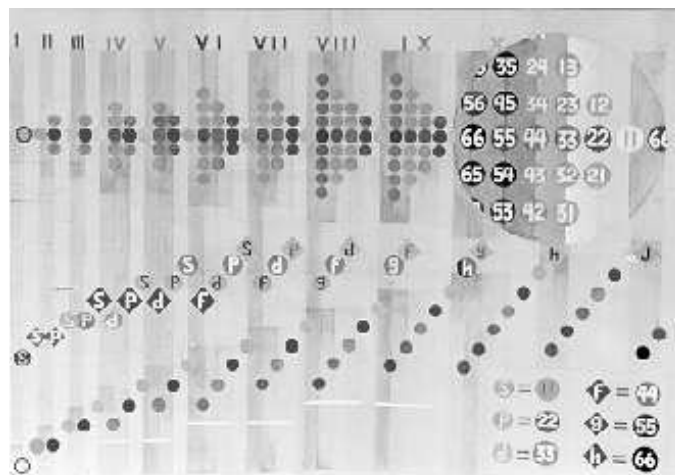


FIG. 1. The pine-tree form of the periodic law

and we can paint it as an abstract picture,

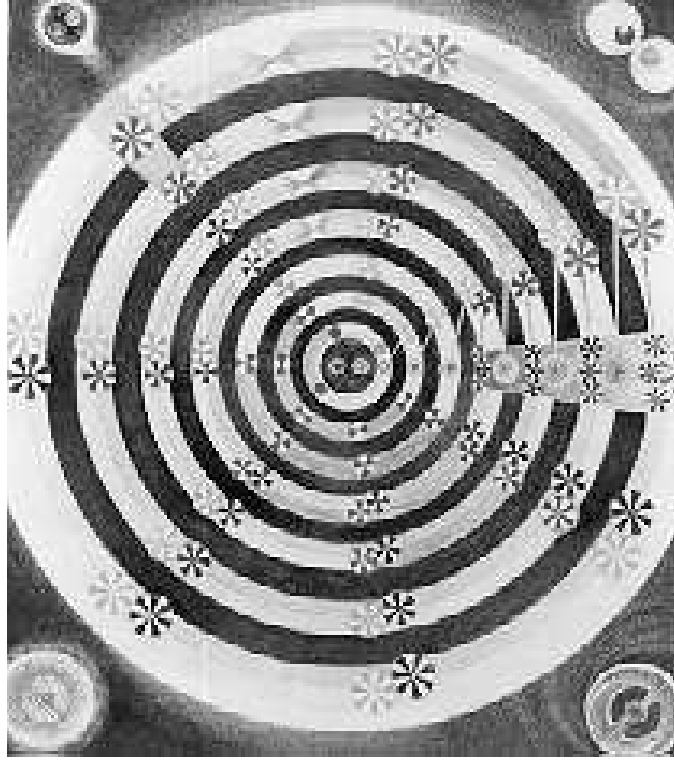


FIG. 2. The spiral form of the periodic law

The pictures Fig.1 and Fig.2 have a very special significance besides the periodic law. Thus, corresponding to the $SU(2)$, $SU(3)$, and $SU(n)$ groups we have the periodic laws of doublet, triplet, and multiplet elements. They give us a model of the evolution in the pine-tree and the spiral from simplex to complex, from low-level to high-level.

IV. CONCLUSIONS AND PROSPECTS

There is a truth that everybody knows: the nature is difficult to understand for us when it has not been discovered yet, but it is really beautiful when we understand it. This is science, where the ultimate worth of one's ideas is that they lead to a genuine understanding of nature. And an idea or a theory not only represents daily phenomena but also makes predictions that survive comparison with observation and experiment based on fundamental principles and laws that underlie the universe. By the present article, we can confirm an existence of an ultimate principle or an ultimate law from which others could be found out.

We realize that the most important principle of nature is that all observable properties of things are about relationships. The difference has meaning in direct relationship. Actions are in interaction in mutual relationships. Contradictions are generated in mutual-rejection

relationships. Transformation, change, or motion, variation, or exactly contradiction solving, does experience of relationships. Even space and time must be spoken about in terms of relationships. There is no such a thing as space independent of that which exists in it and no such thing as time apart from change. These mean that the universe is in unification, and this unification is created by relationships of causality.

Relationships of causality give us an ultimate law which is called the law of causality. Following the logical source of the law of causality, we open up limitless horizons of a view of the universe. The Universe was born from Nothing, and its evolution created beautiful worlds of numerous form of things whose structure and complexity can be self-organized. We understand that there are natural processes, easily comprehensible, by which organization can arise naturally and spontaneously, without any need for a maker outside of the system. That is confirmed in the present article.

Although the results we obtained in this article is similar to ones that modern physics discovered, we open to the possibility that the answers to many of the questions we have about why phenomena, things, the elementary particles, or the fundamental forces are as they are and not otherwise, and why the nature created beautiful worlds in the way we see not otherwise. Moreover, we have the expectation to answer the greatest questions: "Where does the universe come from?" or "What is the

evolution, the self-organization, the variety, or the fate of the universe?" or "Where does the matter come from and where is the missing matter?"

In the present article's view of the universe, everything is from to nothing, everything may be smooth at the beginning but does not stay smooth forever, because today our universe is very inhomogeneous. So the universe was not perfectly homogeneous either when it began or shortly after it began but, rather, it was slightly inhomogeneous. It had small regions where the density of matter was slightly higher than average and other regions where it was slightly lower than average. They are really tiny. Yet tiny as they are to begin with, these inhomogeneities are very important because they are the seeds from which particles, star clusters, galaxies and, eventually, human beings, will grow in the way that their structure must be formed systematically from within by natural processes of self-organization such as periodic, multiplicative, combinative, evolutive, and etc. principles.

Our universe has a variety of mysteries to discover. But we cannot say everything in a day. Many and very many beautiful worlds are in future of our discovery. This article is only the first one we would like to open up a first view of the universe. The first is the key idea behind evolution of the universe from nothing, the second the idea behind the principle of causality. These themes

are only essential for understanding what happened, is happening, and will happen in the universe.

Of course, this does not mean that theories will be discovered, based on the principle of causality, are proven to be right; only observation and experiment can, in the end, tell us that. But a definite fact that we enter the 21st century with new ideas and wide horizons, with much to do and everything to talk about.

ACKNOWLEDGMENTS

We would like to thank Dr. D. M. Chi for useful discussions and valuable comments.

The present article was supported in part by the Advanced Research Project on Natural Sciences of the MT&A Center.

¹ D. M. Chi, *The Equation of Causality*, (1979).

² N. T. Anh, *Causality: The Nature of Everything*, (1991).